City of Santa Fe Springs

Transportation Study Guidelines

February 2023

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1 Introduction

There are four questions in the section XVII of California Environmental Quality Act (CEQA) Transportation Checklist.[1] Would the project:

a. Conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?

b. Would the project conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?

c. Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?

d. Result in inadequate emergency access?

The second question (b) is referring to the CEQA Guidelines section 15064.3, subdivision (b), which describes potential impacts to Vehicle Miles Traveled (VMT). VMT is the new performance measure to determine significant transportation impacts under CEQA, after California Senate Bill 743 (SB 743) eliminated level of service (LOS).

In response to SB 743 and the termination of Los Angeles County Congestion Management Program (CMP) provisions, the City of Santa Fe Springs has established the following guidelines for the preparation of a Transportation Impact Study (TIS) Report.

The purpose of these guidelines is to establish standard procedures for consistent analysis and evaluation. It is strongly recommended that the transportation professional representing developers, property owners and/or architects consult with City staff prior to commencing the study, making assumptions, and/or performing any traffic data collection.

The document is organized into two sections. The first section is focused on regional travel and new procedures related to evaluating VMT, as required by SB 743, and identifying significant impacts for purposes of CEQA. Project screening to evaluate the level of analysis needed, analysis methods, thresholds of significance, and example mitigation options are addressed. The second section is focused on the Local Transportation Assessment (LTA) and includes both vehicular level of service (LOS) analyses and multimodal assessments to document consistency with General Plan policies for safe and efficient local operations. For more information about the City's goals regarding LOS, local safety, and operational guidance please refer to the Circulation Element of the City's General Plan.

[1] 2021 CEQA Statue & Guidelines, Page 340, https://www.califaep.org/docs/CEQA_Handbook_2021.pdf

2 CEQA Regional Analysis Overview

2.1 Vehicle Miles Traveled (VMT) Analysis

Pursuant to the adoption of SB 743, the implementation of CEQA guidance for transportation impact assessment in the City of Santa Fe Springs includes the following:

- VMT Screening: The first step in the traffic analysis process is to determine when a VMT analysis is required. The City of Santa Fe Springs requires that VMT screening be conducted based on the recommendations of the Governor's Office of Planning & Research (OPR). OPR recommends that projects be screened from a VMT analysis based on their size, location, or accessibility to transit. In addition, transportation projects that are not adding new travel lanes may be screened from further VMT analysis. Details on applying the VMT screening process are provided in Table 1.

- VMT Analysis Methodology: If the project is not screened from needing a VMT analysis, the Southern California Association of Governments (SCAG) regional Travel Demand Model should be used to estimate a project's VMT. OPR recommends that VMT be reported as "Home-Based VMT" per capita for residential projects and "Home-Based Work VMT" per employee for office projects. Per OPR guidance, the City of Santa Fe Springs would evaluate each component of a mixed-use project independently and apply the significance threshold for the land use types proposed. Total VMT and/or VMT per service population (total of residents and employees) is to be reported for area plans, large-scale retail projects, or other project types, such as special event venues.

- VMT Impact Thresholds: Projects exceeding a level of 15 percent below the Baseline VMT (reported as VMT per capita, per employee, or per service population) are considered to have a significant VMT impact. For regional retail projects, projects resulting in a net increase in total Citywide VMT are considered to have a significant VMT impact. The City of Santa Fe Springs has defined the area encompassed by the City boundary and the City's Sphere of Influence (SOI) as the geographic area for impact analysis relating to residential and employment uses. The scale of analysis for retail projects will be based on changes to VMT for an area to be determined in consultation with City staff. The study area would be dependent on factors such as land use, scale, and proximity to the City's borders.

- VMT Mitigation: The types of mitigation that effect VMT are generally those that reduce the number of single-occupant vehicles generated by the site and/or reduce the distance of trips to/from the site. This can be accomplished by

changing the land uses being proposed or by implementing transportation demand management (TDM) measures.

Attachment A shows the flowchart of VMT assessment for the City of Santa Fe Springs. The following sections describe the CEQA analysis process in greater detail.

2.2 VMT Screening Criteria

Based on the guidance provided by OPR, land use projects can be screened from a VMT analysis based on their size, location, or accessibility to transit. In addition, transportation projects that are not adding new travel lanes may be screened from further VMT analysis. Screening opportunities in the City of Santa Fe Springs are described in Table 1. A project only needs to satisfy one of the screening criteria to be exempt from requiring further VMT analysis.

In the screening criteria of transit proximity, projects located in a Transit Priority Area (TPA) may be screened out from conducting a VMT analysis because they are presumed to have a less than significant impact absent substantial evidence to the contrary. The City of Santa Fe Springs has determined TPAs to be areas within one-half mile of where two or more 15-minute (during commute hours) bus routes intersect or within one-half mile of a corridor served by 15-minute (during commute hours) bus service.

Figure 1 shows the TPAs within the City of Santa Fe Springs. Transit service may change over time; Figure 1 includes the TPAs in Santa Fe Springs as of May 2022 and includes future conditions when the Eastside Transit Corridor Phase 2 Project (Metro L Line) is complete.[2] As project applicants seek to use this screening criteria, they are responsible for reviewing the current transit service and demonstrating how their project qualifies for this screening criteria. Applying the TPA screening for the future Eastside Transit Corridor Train station would only be appropriate when the anticipated opening year of a project aligns with anticipated opening year of the Metro L Line. Please refer to Figures 2, 3, and 4 for Citywide mapping of high/low VMT areas for daily total VMT, residential VMT, and employment VMT, respectively.

[2] Bus schedules were adjusted in August 2020 in response to COVID-19.

TABLE 1: VMT SCREENING GUIDANCE	
Screening Categories	***Project Requirements to Meet Screening Criteria***
Project Size	A project that generates 110 or fewer daily trips.
Locally Serving Retail	A project that has locally serving retail uses that are 50,000 square feet or less, including specialty retail, shopping center, grocery store, pharmacy, financial services/banks, fitness center or health club, restaurant, and café. If the project contains other land uses, those uses need to be considered under other applicable screening criteria. Proposed projects less than 50,000 square feet that are unique uses or regional draws, may require additional information or evidence that they will be local-serving.
Project Located in a Low VMT Area	A residential or office project that is located in a Traffic Analysis Zone (TAZ) that is already 15% below the City and Sphere of Influence (SOI) Baseline VMT. (See Figures 2-4.)
Transit Proximity	For existing baseline projects that are located within a ½ mile of where two or more 15-minute (during commute hours) bus routes intersect or within a ½ mile of a corridor served by 15-minute (during commute hours) bus service may be eligible. Future baseline conditions would also include the area located within a ½ mile of the Eastside Transit Corridor Phase 2 Project. In addition to the above criteria, the project should meet the following criteria: • A Floor Area Ratio (FAR) of 0.75 or greater • Is consistent with the applicable SCAG Sustainable Community Strategy (SCS) (as determined by the City) • Does not provide more parking than required by the City • Does not replace affordable housing units
Affordable Housing	A residential project that provides affordable housing units; if part of a larger development, only those units that meet the definition of affordable housing satisfy the screening criteria.
Transportation Facilities	Transportation projects that promote non-auto travel, improve safety, or improve traffic operations at current bottlenecks, such as transit, bicycle and pedestrian facilities, intersection traffic control (e.g., traffic signals or roundabouts), or widening at intersections to provide new turn lanes.

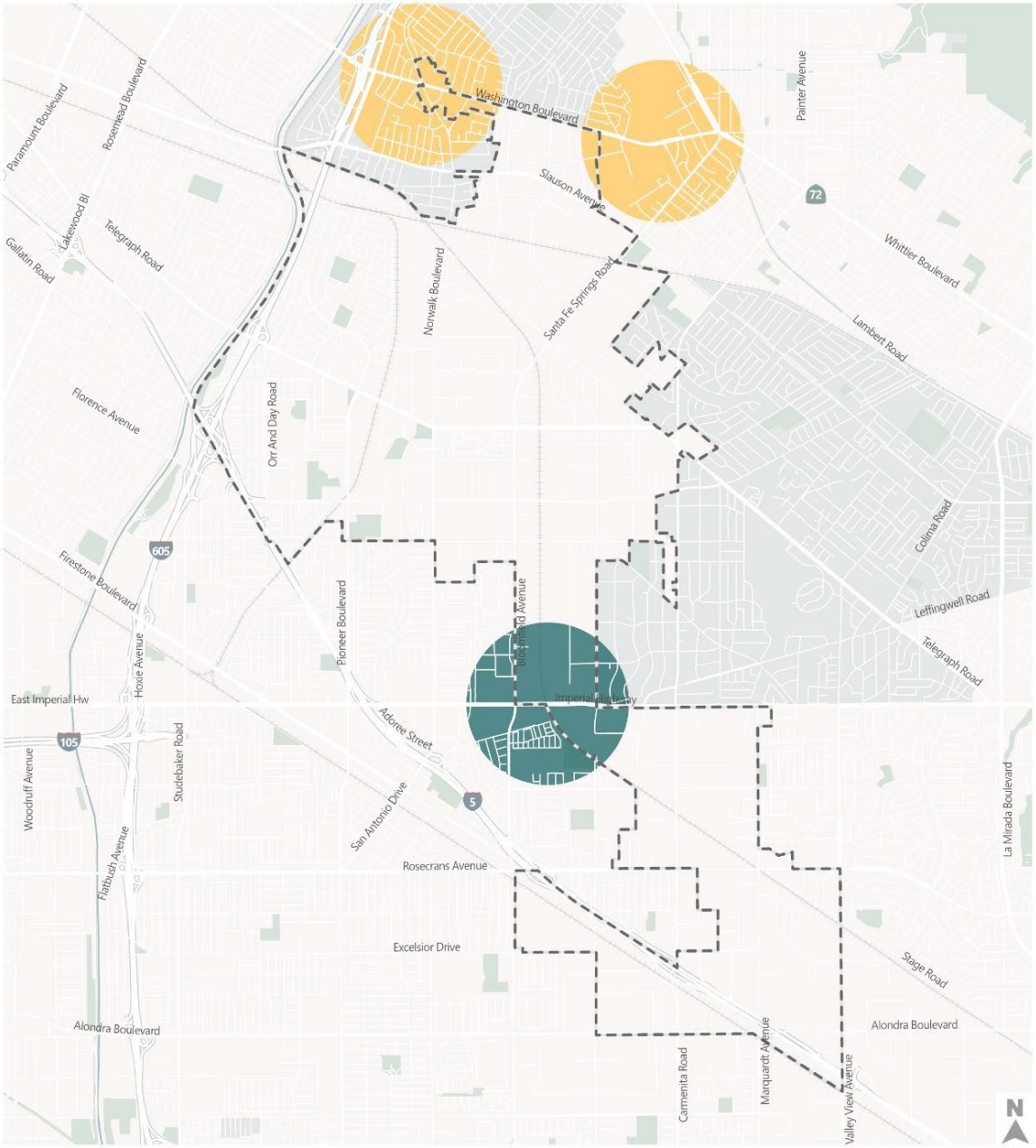
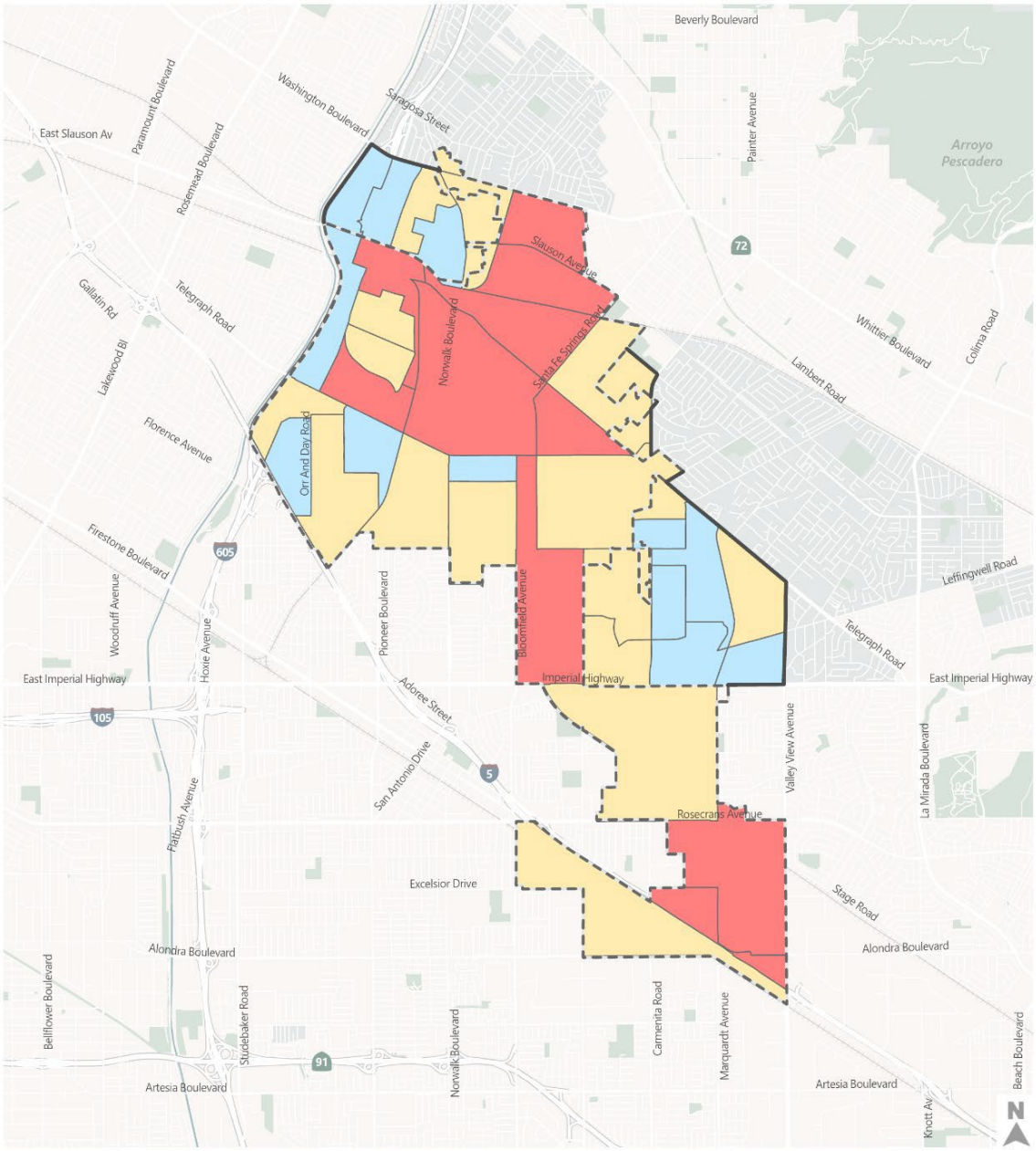


Figure 1

Existing TPA (Metrolink Station)
Future TPA (L Line Stations)
Santa Fe Springs

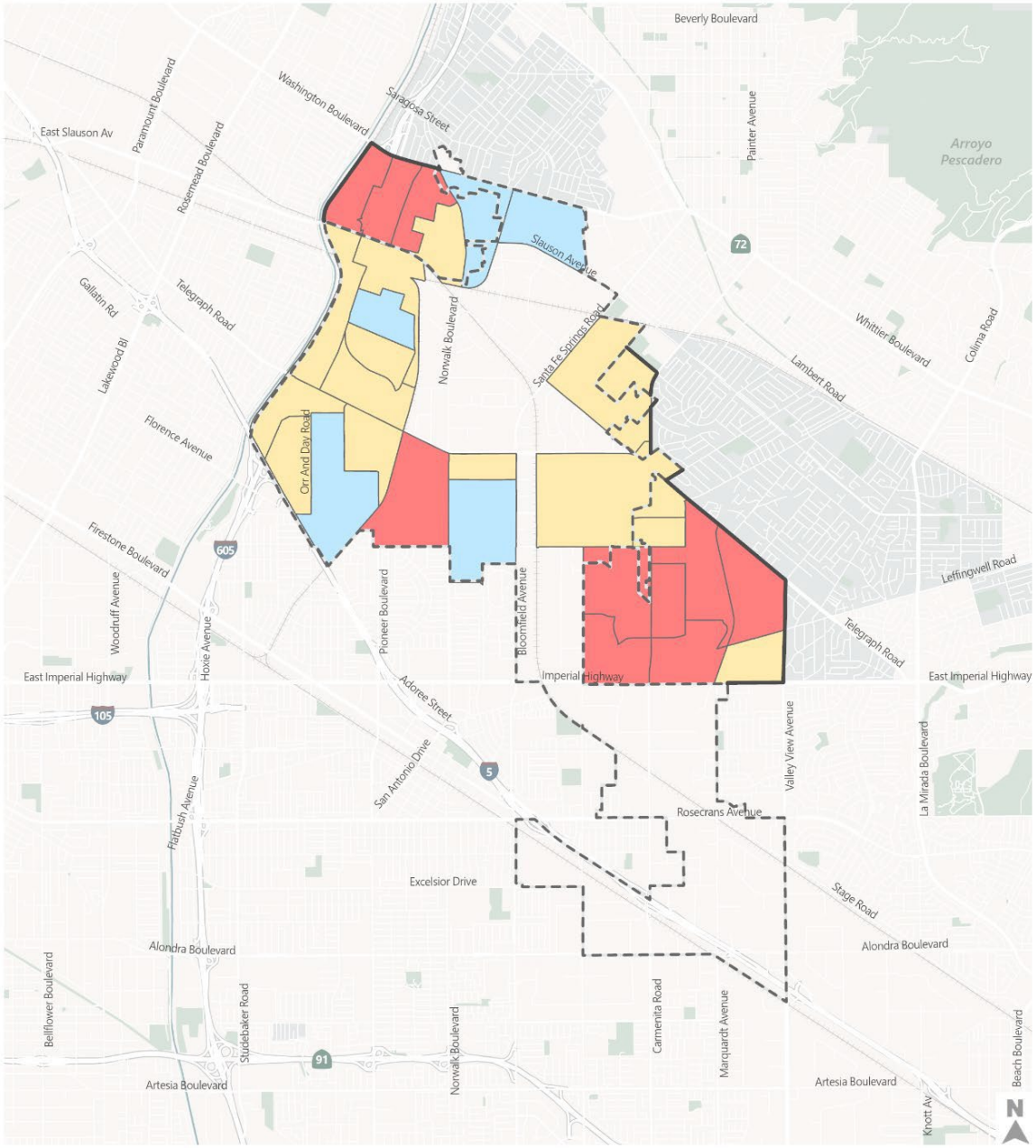
Transit Priority Areas (TPAs) Santa Fe Springs
Future & Existing



Santa Fe Springs
Sphere of Influence
Higher than City Baseline
0-15% below City Baseline
<-15% below City Baseline

Figure 2

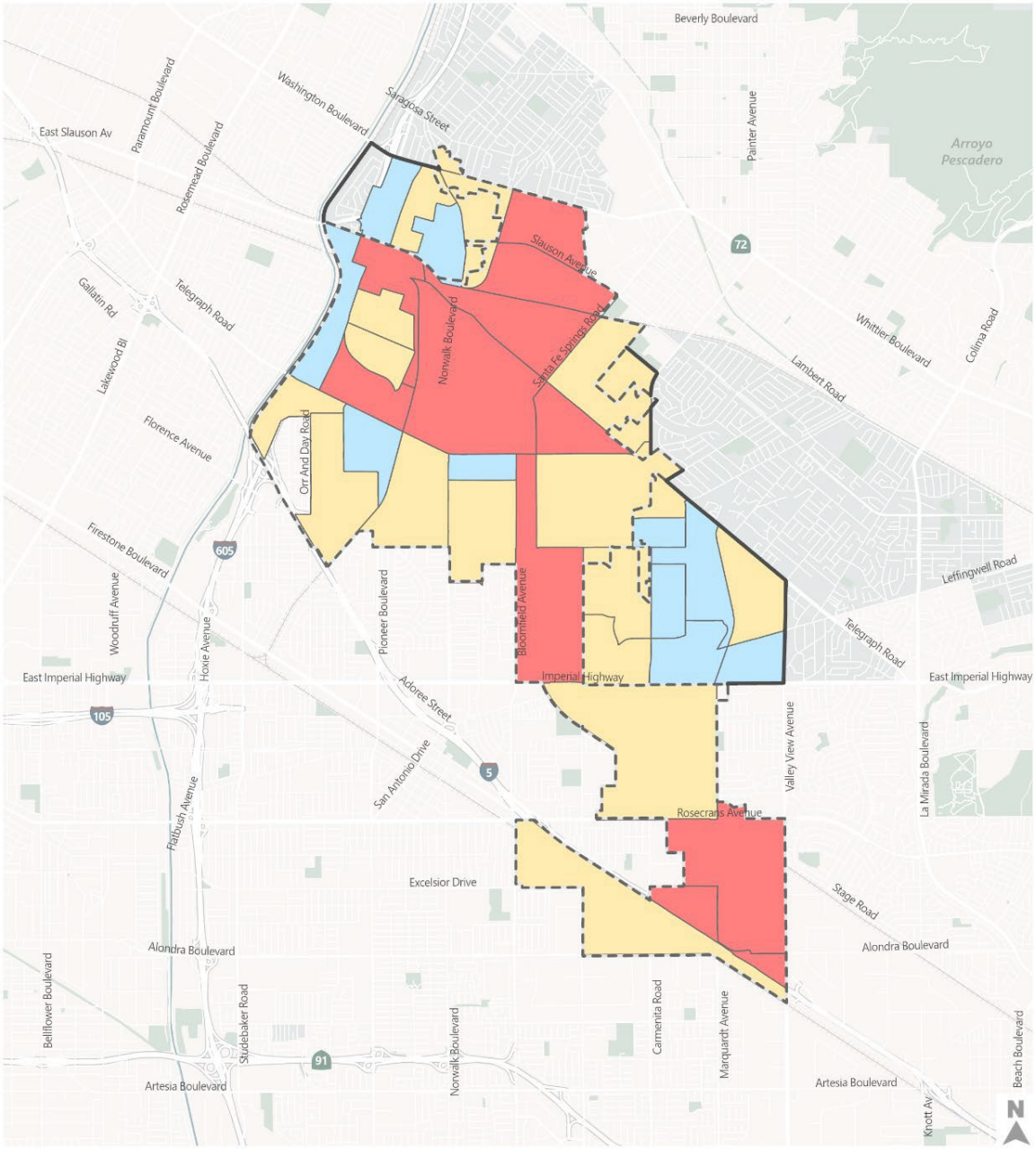
High/Low VMT for Santa Fe Springs
Total VMT per Service Population



Santa Fe Springs
Sphere of Influence
Higher than City Baseline
0-15% below City Baseline
<-15% below City Baseline

Figure 3

High/Low VMT for Santa Fe Springs
Home-Based VMT per Capita



Santa Fe Springs
Sphere of Influence
Higher than City Baseline
0-15% below City Baseline
<-15% below City Baseline

Figure 4

High/Low VMT for Santa Fe Springs Work-Based VMT per Employee

2.3 VMT Analysis Methodology

For projects that do not meet any of the screening criteria in Table 1, a VMT analysis is required and should rely on a reasonable standard of care to develop trip generation and trip length estimates for the project uses. For land use plans (e.g., Specific Plan or General Plan) and projects consisting of residential, office, industrial, or retail, the VMT analysis should be conducted using the SCAG regional Travel Demand Model. For other project types, such as a performing arts center or special event venues, the VMT analysis should be customized to determine the unique trip generation and trip length characteristics of the proposed uses. This approach should be determined in consultation with City of Santa Fe Springs staff.

VMT analysis should provide 'project generated VMT' under the scenarios below. Project generated VMT shall include the VMT generated by the site that is then compared back to the City's threshold of significance. The VMT analysis should consider the potential impacts of the project under both existing and future/cumulative conditions as follows:

2.3.1.1 Existing/Baseline Conditions

Project-generated VMT should be estimated for the proposed land uses under existing/baseline conditions. VMT can be estimated using the SCAG regional Travel Demand Model and should be reported as Total VMT per service population (area plans, large-scale retail projects, or other project types, such as special event venues; see Figure 2), Home-Based VMT per capita (residential projects; see Figure 3), and Home-Based Work VMT per employee (office, industrial or other employment-generating projects; see Figure 4). For land use plans, Total VMT per service population or Total VMT can be used to determine potential impacts. Baseline conditions typically represent the year of the Notice of Preparation (NOP).[3] Interpolation between SCAG's base year model and future year model may be required to identify the VMT representative of the baseline year[4]. Per OPR guidelines, truck-generated VMT analysis is not required for transportation impact assessment.[5] The traffic effects of trucks are studied under the Local Transportation Assessment.

2020 baseline VMT estimates are based on data derived from the SCAG regional Travel Demand Model. Updates should be done on a four-year cycle, following when SCAG updates their most recent RTP/SCS regional model for local agency use.

[3] If an EIR is required, baseline conditions should be tied to the NOP date. If an EIR is not required, the baseline may be tied to when an application is deemed complete.

[4] Base year and future year SCAG's model information are based on SCAG Regional Transportation Plan (RTP) Scenario years and can be requested from SCAG.

[5] Truck-generated VMT is not analyzed under a CEQA transportation impact study, however, it is analyzed as part of CEQA's air quality and greenhouse gas analysis.

Existing/Baseline plus Project

The project land use would be added to the project TAZ or a separate TAZ[6] would be created to contain the project land uses. A full model run of the baseline scenario year would be performed and VMT changes would be isolated for the project TAZ and across the full model network. If this scenario results in a less-than-significant impact, then additional cumulative scenario analysis may not be required (see next section).

2.3.1.2 Cumulative Conditions

This data is available from the SCAG model. However, a less than significant impact under Existing/Baseline conditions would also result in a less than significant cumulative impact as long as the project is consistent with the SCAG Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS).

2.3.1.3 Cumulative plus Project

The project land use would either be added to the project TAZ or a separate TAZ would be created to contain the project land uses using the future year SCAG model that reflects cumulative conditions. VMT should be reported as Total VMT per service population, Home-Based VMT per capita, or Home-Based Work VMT per employee. For land use plans, Total VMT per service population or Total VMT can be used to determine potential impacts.

The baseline and cumulative "plus project" scenarios noted above will summarize project generated VMT (per service population, per capita, or per employee) and compare it back to the appropriate benchmark noted in the thresholds of significance.

Project-generated VMT shall be extracted from the travel demand forecasting model using the origin-destination trip matrix and shall multiply that matrix by the final assignment skims. A glossary of terms and a detailed description of this process is attached to these guidelines in Attachment B and C.

2.3.2 VMT Impact Thresholds

OPR has identified 15% below the average baseline VMT as the threshold for identifying a significant VMT impact for land use projects and plans. This is based on research conducted to determine the VMT reduction needed to help the State achieve its climate goals. The California Air Resources Board has quantified the need for VMT reduction to meet the State's long-term climate goals and OPR sees reducing VMT to 15% below existing conditions as a reasonable threshold for new development projects. OPR guidance is also provided for transportation projects. For roadway widening and transportation infrastructure projects, a significant impact would occur if the project increased the baseline VMT in the study area. The baseline VMT in the City of Santa Fe Springs and

[6] Project land use will be added to a separate TAZ accounted separately for other existing land use in the TAZ.

Sphere of Influence (SOI) are presented in Table 2A. The VMT thresholds for projects and plans in the City of Santa Fe Springs are summarized in Table 2B.

TABLE 2A: BASELINE VMT IN THE CITY OF SANTA FE SPRINGS AND SOI[7]	
VMT Metrics	***Average VMT (2020 Baseline)***
Total VMT per Service Population	33.1
Home-Based VMT per Capita	17.2
Home-Based Work VMT per Employee	18.3

TABLE 2B: VMT IMPACT THRESHOLDS	
Project Type	***Threshold for Determination of Significant VMT Impact***
Residential Project	Project exceeds 15% below City + SOI Baseline VMT for home-based VMT per capita
Office (Commercial or Light Industrial) Project	Project exceeds 15% below City + SOI Baseline VMT for home-based work VMT per employee
Regional Retail Project[8]	Project results in a net increase in total VMT in comparison to the City + SOI Baseline VMT
Mixed-Use Projects	Evaluate each project land use component separately using the criteria above
Land Use Plans	Plan exceeds 15% below City + SOI Baseline VMT for Total VMT per service population
Other Land Use Types	Project exceeds 15% below City + SOI Baseline VMT. For land use types not listed above, the City can determine the appropriate VMT metric depending on the project characteristics. For projects that are generally producing job-related travel, the employment generating VMT (home- based work VMT per employee) can be compared to the baseline. For other projects, the total VMT can be compared to the City + SOI baseline to determine if the net change in Total VMT exceeds the baseline without the project.

[7] SCAG model was used to estimate the Baseline VMT metrics.

[8] Per the Governor's Office of Planning and Research (OPR) guidance, regional retail projects are those that exceed 50,000 square feet.

Transportation Projects	Project results in an increase in VMT (induced VMT due to added capacity to roadway network) in the City in comparison to baseline conditions

2.3.3 VMT Mitigation

The types of mitigation that affect VMT are those that reduce the number of single-occupant vehicles generated by the project. This can be accomplished by changing the land uses being proposed or by implementing Transportation Demand Management (TDM) strategies. TDM strategies have been determined to be among the most effective VMT impact mitigators. TDM strategies are reductions available from certain types of project site modifications, programming, and operational changes.

The effectiveness of identified TDM strategies is based primarily on research documented in the 2021 California Air Pollution Control Officers Association (CAPCOA) publication*, Handbook for Analyzing GHG Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity* (CAPCOA, 2021). CAPCOA offers methodology based on preferred literature, along with methodology based on alternative literature, for each strategy. The strategies described in Attachment D are a sample of the options most effective in areas like the City of Santa Fe Springs. For a comprehensive list of available TDM strategies, please refer to Handbook for Analyzing GHG Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Attachment D to this document provides a comparison of the VMT reductions that can be expected from the strategies in the CAPCOA guidance with anticipated reductions as described in literature that has been published after 2021.

The CAPCOA document contains detailed equations on applying these TDM reductions given the land use type and built environment context. The percent reduction shown in Attachment D should not be directly applied to a project. In addition, some TDM strategies have complementary benefits on reducing VMT and need to be considered in combination and not individually.

Specific mitigation strategies need to be tailored to the project characteristics and their effectiveness needs to be analyzed and documented as part of the environmental review process to determine if impacts could be mitigated or if they would remain significant and unavoidable. Given that research on the effectiveness of TDM strategies is continuing to evolve, feasible mitigation measures should be considered based on the best data available at the time a project is being considered by the City and documented accordingly in the Transportation Impact Study.

The City of Santa Fe Springs prepared a VMT Evaluation Tool and Users' Guide to assist developers in screening and estimating project-generated VMT by land use and calculating VMT reductions associated with certain VMT-reducing mitigation measures. The VMT Evaluation Tool demonstrates how a mitigation measure, or a combination of complementary measures, can affect a project's VMT.

3 Local Transportation Assessment Overview

In addition to VMT analysis for CEQA, the City of Santa Fe Springs requires an evaluation to identify potential safety and operational issues when applied against established City criteria. This approach continues to use Level of Service (LOS) to evaluate land development and infrastructure projects and adds elements to ensure that multimodal transportation considerations are consistent with the City's General Plan policies.

In the event a development project significantly degrades the effective use or safety of City streets, improvements may be required. Required improvements should consider transit, bicycle, and pedestrian improvements as well as roadway and operational improvements.

The Local Transportation Assessment (LTA) will analyze the changes in the LOS of designated intersections and/or roadway segments through a progression of scenarios beginning with existing traffic conditions. If any significant degradation of operations is indicated, the LTA will propose feasible improvements that are needed to accommodate the additional travel needs generated by the project.

The City standard for the minimum LOS for intersections and roadway segments is:

LOS D or better

The traffic analysis should not use any traffic counts that are more than four months old without the advanced approval of the City Traffic Engineer. If traffic counts taken within the last four months are not available, then new traffic counts shall be collected by a qualified data collection firm. Traffic counts are required to be performed within typical traffic conditions. Traffic count collection shall not be performed during:

1. Holidays (or holiday periods)
2. Construction periods (when there are existing roadway detours, traffic control, or construction impacting study intersections and roadways)
3. Other significant circumstances (e.g. national emergencies or special occasions that may alter typical traffic conditions)

Any work performed on City right-of-way will require a permit. The City can provide a "No fee permit" after receiving a proposed work schedule.[9]

[9] City street sweeping schedules will need to be reviewed.

3.1 Local Transportation Assessment Study Scope

The City is generally concerned with degradations to traffic operations and safety if:

1. Traffic generated (autos & truck) by a project alone or cumulatively with other related projects, when added to existing traffic volumes, exceeds certain capacity thresholds of an intersection or roadway, contributes to an unacceptable LOS, or exacerbates an existing congested condition.
2. Project generated traffic (autos & truck) interferes with the existing traffic flow (e.g., due to the location of access roads, driveways, and parking facilities).
3. Proposed access locations do not provide for adequate safety (e.g., due to limited visibility on curving roadways- stopping site distance may be required)[10].
4. Nonresidential uses generate commuter or truck traffic through a residential area.
5. Project generated traffic significantly increases on a residential street and alters its residential character.
6. Turning movements (autos & truck) are identified to impact existing and/or future conditions.
7. Any vehicle queuing for all movements on principal and collector roadways adjacent or less than 1,000 feet from the project site.

The LTA must be prepared by a registered Civil or Traffic Engineer, or qualified transportation professional. The LTA is generally needed if a project generates any additional vehicle trips that are assigned to any movement (left/through/right-turns to any intersection approach) at a signalized intersection in the peak hour or where other possible adverse operational degradations may occur, as discussed below. Study locations would be determined in consultation with City staff and should include:

- All primary project driveways
- All signalized intersections within 1,000 feet of primary project driveways, regardless of jurisdictional boundary
- Unsignalized intersections within 1,000 feet of the project site or that serve as project access points regardless of jurisdictional boundary
- All signalized intersections within a half mile radius to the project site where the project would add trips, regardless of jurisdictional boundary

[10] The result of this safety analysis can be used for CEQA checklist item c.

3.2 Local Transportation Assessment Report Contents

3.2.1 Project Description

The following information is required:

1. A description of the project, including those factors which quantify traffic generators, e.g., dwelling units, square feet of office space, persons to be employed, restaurant seats, acres of raw land, etc. For residential developments, the description should indicate the types of residence (e.g., one level or townhouse condominiums, and if its use is for families, adults, or retirees).
2. A site plan showing proposed driveways, streets, internal circulation, and any new parking facilities on the project site.
3. A study area map showing the site location and the study area relative to other transportation systems.

3.2.2 Transportation Circulation Setting

The following information is required:

1. Existing and Proposed Site Uses: A description of the permitted and/or proposed uses of the project site in terms of the various zoning and land use categories of the City, and the status and the usage of any facilities currently existing on the site.
2. Existing and Proposed Complete Streets Environment Assessment: This section is intended to describe the existing pedestrian, bicycle, and transit facilities in the area of the proposed project and whether the proposed project degrades or augments physical conditions and/or adds substantial pedestrian, bicycle, or transit demand to inadequate facilities. The project should describe and/or provide figures that document existing and planned pedestrian, bicycle, and transit facilities within ¼ mile of the site that may be used by travelers between the project and uses such as parks, government offices, bike/walking trails, schools, bus stops, libraries, medical centers, and other pedestrian generators. The inventory should include missing sidewalks, marked crossings, curb extensions, transit amenities (bench, shade, trash, transit info), bike lanes/routes, and relevant active transportation infrastructure.
3. Existing and Proposed Roadways and Intersections: A description of existing streets and roadways, both within the project site (if any) and in the surrounding area. Include information on the roadway classifications, the number of lanes and roadway widths, signalized intersections, separate turn lanes, and the signal phases for turning movements.

3.2.3 Analysis and Identification of Operational Deficiencies

The following information is required in the LTA:

Trip Generation Analysis

Tabulate the estimated number of daily trips and A.M. and P.M. peak-hour trips generated by the proposed project entering and exiting the site. Trip generation factors and source are to be included. The trip generation rates contained in the latest edition of the Institute of Transportation Engineers Trip Generation manual should generally be used unless better information is available.

There may be a trip reduction due to internal and/or pass-by trips. Internal trip reduction can only be applied for mixed-use types of developments and pass-by trip reduction for retail/commercial types of developments. Internal or pass-by trip reduction assumptions will require analytical support based on verifiable actual similar developments to demonstrate how the figures were derived and will require approval by the City.

Trip Distribution

Diagrams showing the percentages and volumes of the project and nearby project's A.M. and P.M. peak-hour trips logically distributed on the roadway system must be provided. If it is assumed that new routes will alter traffic patterns, adequate backup including traffic distribution maps must be provided showing how and why these routes will alter traffic patterns.

The study area should include arterial highways, freeways, and intersections generally within a one-mile radius of the project site.

Related Projects List

A list of related projects that are within a one-half mile radius of the project site and would reasonably be expected to be in place by the project's build out year must be included in the report. Related projects shall include all pending, approved, recorded, or constructed projects that are not occupied at the time of the existing traffic counts. Related projects can be obtained from the Santa Fe Springs Planning department.

A table and a map showing the status, project/zone change/conditional use permit/parcel map/tract number, and the location of each project must be provided.

LOS Analysis and City's Criteria

If it appears that the project's generated traffic alone or together with other projects in the area could worsen the LOS of an intersection or roadway, a "before" and "after" LOS analysis is necessary. The latest version of the Highway Capacity Manual (HCM) should be applied to assess existing and future LOS at intersections.

Intersection LOS analysis and calculation work sheets, as well as diagrams showing turning volumes shall be included in the report for the following traffic conditions.

i. Existing traffic;

ii. Existing traffic plus ambient growth to the year the project will be completed;

iii. Traffic in (ii) plus project traffic;

iv. Traffic in (iii) with the proposed operational enhancements (if necessary);

v. Traffic in (iii) plus the cumulative traffic of other known developments; and

vi. Traffic in (v) with the proposed operational enhancements (if necessary)

The project's effect on two-lane roadways should also be analyzed for all the above traffic conditions if those two-lane roadways are used for site access. LOS analysis contained in the Highway Capacity Analysis, Chapter 8, Two-Lane Highways, should be used to evaluate the project's effect.

The City standard for the minimum LOS for intersections and roadway segments is LOS D or better. Intersections in the City that do not meet these targets are considered deficient.

Signalized intersections will require improvements if the following conditions are met:

- For an intersection with LOS D or better, the addition of project traffic results in the degradation of intersection operations to LOS E or F.
- For an intersection with LOS E or F, the addition of project traffic results in any degradation of intersection operations.

Unsignalized intersections will require improvements if the following conditions are met:

- For an intersection with LOS D or better, the addition of project traffic results in the degradation of any individual movement at the intersection to LOS E or F, or for an intersection with LOS E or F, the addition of project traffic results in the degradation of any individual movement, and
- The intersection meets peak hour signal warrants either caused by project volumes, or project volumes are added at an intersection that meets peak hour signal warrants in the baseline scenario(s). Peak hour signal warrants should be determined based on the latest California Manual on Uniform Traffic Control Devices (CA MUTCD).

Roadway segments shall be reviewed on a case-by-case basis. Deficiencies identified to be improved will be determined in coordination with the City Traffic Engineer based on various factors including determined LOS, anticipated street improvements, and LOS at critical intersections along the roadway segment.

Traffic Signals

The following information is required if the installation of a traffic signal is being considered:

Traffic signal warrant analysis using the State of California Department of Transportation (Caltrans) Peak-Hour (Figures 9-8 and 9-9 of Caltrans Traffic Manual) and Estimated Average Daily (Figure 9-4 of Caltrans Traffic Manual) Traffic Warrant Analysis should be provided. In certain situations, the other available signal warrants may also be required. If the installation of signals is warranted with the addition of the project's traffic, then the installation will be the sole responsibility of the project. If it is warranted with cumulative traffic of the project and other related projects, the following formula should be used to calculate the project percent share.

Project Percentage Share = Project Traffic / (Project + Other Related Projects Traffic)

The project percent share should be based on the peak-hour volumes that warrant signals. If both peak hours satisfy the installation of signals, the average of the two peak-hour volumes should be used in the percent share analysis.

Operational Enhancement Measures

The following information is required if study intersections or roadway segments are found to be deficient:

Identify feasible operational enhancements to reduce the projects' operational deficiencies to a level below the threshold identified. Also, identify those measures which will be implemented by others. Those measures that are assumed to be implemented by others will be made a condition of approval for the project to be in place prior to issuance of building permits. It is important to note that some of the operational enhancement measures may require additional CEQA analysis (e.g. VMT analysis) and could include the following:

a. Traffic Engineering Techniques

   i. Locate access points to optimize visibility and reduce potential conflict.

   ii. Design parking facilities to avoid queuing into public streets during peak arrival periods.

   iii. Provide additional off-street parking (e.g. for Transportation Network Companies (TNCs) or commercial vehicle delivery).

   iv. Dedicate visibility easements to assure adequate sight distance at intersections and driveways.

   v. Signalize or modify traffic signals at intersections.

vi. Install left-turn phasing and/or multiple turning lanes to accommodate particularly heavy turning movements.

vii. Provide left- or right-turn lanes to lessen interference with the traffic flow.

viii. Prohibit left turns to and from the proposed development.

b. Contribute to a benefit district to fund major capital improvements

i. Construct a grade separation.

ii. Improve or construct alternate routes.

iii. Complete proposed Capital Projects in the City's Capital Improvement Program.

iv. Improve freeway interchanges (bridge, widening, modifications, and etc.)

c. Transportation System Management (TSM) Techniques[11]

i. Establish flexible working hours.

ii. Encourage employee use of carpools and public transportation (specific measures must be indicated).

iii. Establish preferential parking for carpools.

iv. Restrict truck deliveries to Major and Secondary highways and encourage deliveries during the off-peak hours.

v. Establish a monitoring program to ensure that project traffic volumes do not exceed projected traffic demand.

On-Site Parking Analysis

This analysis will address the on-site parking supply versus parking required per City code. If the proposed development is of mixed-use type, a table shall be included presenting each land use, its size, and the code parking requirement. This table should clearly indicate how the code parking was calculated and include the proposed on-site parking supply together with the resultant surplus or deficit from code requirements.

Should the on-site parking supply be less than required by the City code, a detailed explanation justifying a reduction to the code requirement must be included. Note that this does not eliminate

[11] Contributions to a benefit district and/or TSM techniques may not be used to lower LOS in the capacity calculations.

the need for any zoning code variance. Shared parking evaluations will be considered when appropriate.

Access and Circulation Analysis

The project's effects on access points and on-site circulation shall be analyzed. The analysis shall, as appropriate, include the following:

a. Number of access points proposed for the project site.

b. Space between driveways and intersections.

c. Potential signalization of driveways.

d. On-site stacking distance. (including uses with a drive thru.)

e. Shared access.

f. Turn conflicts/restrictions.

g. Adequate site distance.

h. Driveway improvements.

i. Pedestrian connections.

j. Any other operational characteristics (as identified by City staff).

If the proposed project is a residential or commercial use with privacy gates, the applicant shall provide a stacking analysis for review and approval. The adequacy of the interface with the arterial network will need to be demonstrated and necessary improvements to adjacent intersections may be required.

The LTA report should provide a compilation of any applicable improvements for the project.

4 Attachments

4.1 Attachment A: VMT Analysis Flowchart

Santa Fe Springs VMT Assessment Flowchart

FEHR & PEERS

Steps	Project Questions	Procedural Flowchart

Decision — Analytical process or procedural outcome

Step 1 Screening

Type A TPA Screening

1. Is the project in a Transit Priority Area?

2. Are the following requirements met?
   - Must have a total FAR greater than or equal to 0.75
   - Cannot provide more parking than the City Municipal Code Requirement
   - Must be consistent with SCAG RTP/SCS
   - Cannot replace affordable units with a smaller number of moderate- or high-income residential units

Type B Low VMT Area Screening

1. Is the project located in a low VMT area?

2. Are the following requirements met?
   - The project is composed of similar land use types and of a similar density to the land uses within the project TAZ
   - The project is assumed to generate VMT per person similar to those existing uses

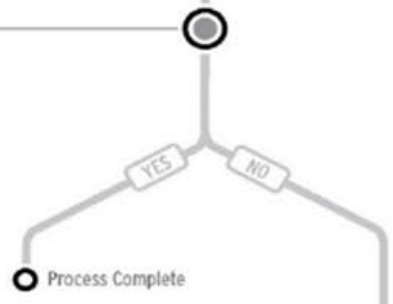
Note: Review jurisdiction's thresholds of significance for definition of low VMT area.

Type C Project Type Screening

Is the project a local-serving project as noted in the Project Type Screening project list in the TIA Guidelines?

These projects include but are not limited to:
- Local serving K-12 schools
- Local-serving retail uses less than 50,000 square feet
- Community and Religious Assembly Uses
- Public Services
- Affordable or supportive housing
- Projects generating less than 110 daily vehicle trips
- Other projects as approved by the City Traffic Engineer

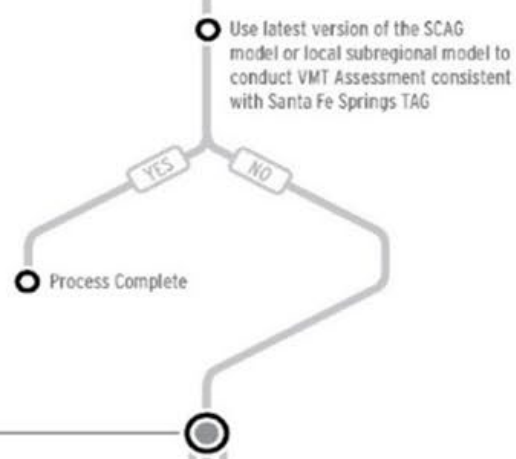
Note: If the project fulfills Type A, B or C screening, the project is presumed to result in a less-than-significant transportation impact.



Step 2 VMT Assessment

What is the project-level VMT and its effect on VMT assessment? Does the project have a less than significant impact?

Details for VMT Assessment are provided in Santa Fe Springs TAG.

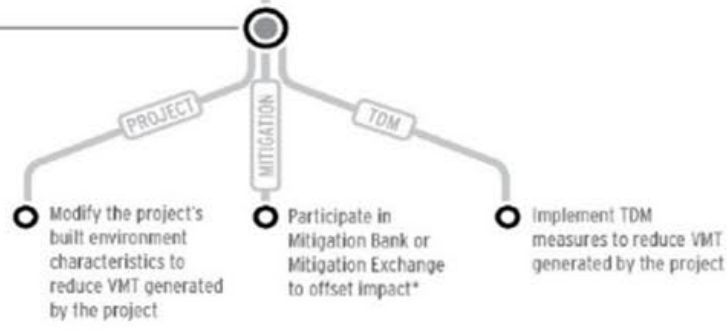


Step 3 Developing Mitigation Measures

What are the options to mitigate VMT impacts?

Note: VMT reductions associated with proposed TDM mitigation measures can be estimated with:
- CAPCOA reduction equations
- Use of Santa Fe Springs TAG to isolate commute VMT
- Samples and effectiveness estimates in Santa Fe Springs TAG
- Engineering judgment combined with substantial evidence as presented to and approved by City Traffic Engineer

*Please note that a Mitigation Bank or Mitigation Exchange program may not be readily available. Check with your local agency.



Abbreviations and Definitions

CAPCOA = California Air Pollution Control Officers Association
FAR = Floor Area Ratio
RTP = Regional Transportation Plan
SCAG = Southern California Association of Governments
SCS = Sustainable Communities Strategy
TDM = Transportation Demand Management
TIA = Traffic Impact Analysis
TPA = Transit Priority Area
VMT = Vehicle Miles Traveled

4.2 Attachment B: Glossary of Terms

Term	Definition
Active Transportation	A means of getting around that is powered by human energy, primarily walking and biking.
Alternative Transportation Modes	Sustainable transportation methods that are alternative to personal motorized vehicles, primarily walking, biking, and riding transit.
Area Development Policy (ADP)	A City-adopted implementation policy of an Area Plan.
Area Plan	A City-adopted plan that coordinates transportation infrastructure improvements and land use development in support of a unique vision for a subarea of the City (e.g. an Urban Village Plan).
Boundary VMT Method or Link based VMT Method	A method used to calculate total VMT on roadways within the City. VMT per service population, a performance metric for General Plan amendments, is based on this method.
Effect	Project-related effects on elements of the transportation system for which no transportation standards or CEQA thresholds of significance have been established by the City. Distinct from "impact".
High-Quality Transit Areas	Areas are within half a mile of a high-quality transit corridor or major transit stop.
High-Quality Transit Corridor	A corridor with fixed route bus service with service intervals no longer than 15 minutes during peak commute hours (Pub. Resources Code § 21155 (b)).
Impact	Refer to a project's impacts as determined by the transportation standards or CEQA thresholds of significance established by the City. Distinct from "effect".
Improvement	A change that addresses the effects, particularly adverse effects, of a project on elements of the transportation system for which no transportation standards or CEQA thresholds of significance have been established by the City. Distinct from "mitigation".
Induced Trips	Increase in traffic volume that occurs soon after a new road is opened or a previously congested road is widened. Increases in roadway capacity are typically quickly filled up with additional traffic.

Term	Definition
Internal trips	Trips between different land use types within the same development project that are accommodated at the project site. Trips that are not internal are those with the project at one end and other locations at the other end.
Intersection Operations Standard	A measure of automobile vehicle delays through a signalized intersection, graded on a scale A through F.
Land Use Plan	A land use plan, such as a specific plan, that identifies the desirable uses and associated infrastructure to guide changes in zoning and development over time.
Major Transit Stop	A rail transit station, a ferry terminal served by either a bus or rail transit service, or the intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods (Pub. Resources Code § 21064.3).
Mitigation	A change that addresses the CEQA impacts of a project on elements of the transportation system for which transportation standards or CEQA thresholds of significance have been established. Distinct from "improvement".
Mixed-Use Project	A development project that combines two or more land uses.
Mode Share	The share of all person-trips to and from a project taken by each transportation mode (personal motorized vehicles, transit, bicycle, and pedestrian).
Net Change in Total VMT	Difference in total VMT in the area with and without the project. Performance metric for regional retail projects and transportation projects.
Origin-Destination (O-D) VMT Method	A method used to calculate the total vehicle-miles traveled a study area (e.g. a development project, the City, or the region) is expected to generate in a day. For a personal motorized vehicle-trip to be included in the VMT calculation using the OD VMT method, one of the trip ends must be within the study area.
Peak Hour	The highest morning or evening hour of travel reported on a transportation network or street.

Term	Definition
Personal Motorized Vehicles	Mainly personal motor vehicles that transport people rather than goods.
Physical VMT Reduction Strategies	Strategies that development projects can physically construct to encourage the shift from driving alone to walking, biking, and riding transit. Include three of the four VMT reduction strategies – project characteristics, multimodal network improvements, and parking measures.
Project VMT	Calculated VMT generation of a development project.
Service Population	The sum of residents and workers in an area such as the City.
Sphere of influence	Area in which travel patterns are expected to change due to a transportation project.
Total VMT	All vehicle-trips (i.e., passenger and commercial vehicles) assigned on the network within a specific geographic boundary (i.e., model-wide, region-wide, city-wide).
Total VMT generated by a project	All vehicle-trips are traced to the zone or zones of study. This includes internal to internal (II), internal to external (IX), and external to internal (XI) trips. May use final assignment origin-destination (OD) trip tables or production (P) and attraction (A) estimates multiplied by distance skims. When the model has multiple assignment periods, OD trip tables and congested skims from each period should be used.

Term	Definition
Total VMT per service population	Same method as above (Total VMT generated by a project) to estimate VMT and then divide by the population and employment of the zone or zones of study. If the model generates vehicle trips from other sources such as students and visitors, then include those variables in the service population. Note that employment is often used as the independent variable for total vehicle trip generation associated with non-residential land uses. This means that vehicle trips made by people other than the employees are accounted for in the trip rate including visitors, customers, vendors, custodians, and delivery companies. For this reason, it is often difficult to draw conclusions about VMT patterns and use of the metric should be limited to analysis scenarios comparing full model runs typically focused on changes at the sub-regional, city, county, or regional scale. Some trip-based models may not use population and employment as trip generation variables. Instead, they will rely on land uses. A 'correspondence' between the model land use input variables and population and employment rates is required for these types of models.
Transportation Demand Management (TDM)	Programmatic measures that discourage drive-alone trips and encourage pedestrian, bicycle, and transit use. One of the four categories of VMT reduction strategies for development projects.
Trip Cap	A maximum number of vehicle-trips that a development project is allowed to generate in a day.
Trip Adjustments	Effort to reduce the number of vehicle-trips to and from a project.
Trip Assignment	An assignment of vehicle-trips to transportation facilities based on trip distribution percentages.
Trip Distribution	A forecast of the travel direction of vehicle-trips to and from a project.
Trip Generation	The estimated total number of vehicle-trips to and from a project.
Vehicle-Miles Traveled	The total miles of travel by personal motorized vehicles in a day. A measure on which a project' transportation impact(s) are based.
VMT per Capita	The sum of VMT for personal motorized vehicle-trips made by all residents of a development project, divided by the total number of residents of the project.

Term	Definition
VMT per Employee	The sum of VMT for personal motorized vehicle-trips made by all workers of an office or industrial development project, divided by the total number of workers at the project.

4.3 Attachment C: Detailed VMT Forecasting Information

This section provides detailed VMT forecasting instructions for use with the Southern California Association of Governments (SCAG) Travel Demand Model. Please note that SCAG periodically updates the travel demand model and the latest version available should be utilized for VMT assessment in the City.

The SCAG travel demand model is a trip-based model that generates daily person trip-ends for each TAZ across various trip purposes (Home-based-work, home-based-other, and non-home-based for example) based on population, household, and employment variables. This may create challenges for complying with the VMT guidance because trip generation is not directly tied to specific land use categories. The following methodology addresses this particular challenge among others.

Production and attraction trip-ends are separately calculated for each traffic analysis zone (TAZ or zone), and generally: production trip-ends are generated by residential land uses and attraction trip-ends are generated by non-residential land uses. Focusing on residential and employment land uses, the first step to forecasting VMT requires translating the land use into model terms, the closest approximations are:

- Residential: home-based production trips
- Employment: home-based work attraction trips

Note that this excludes all non-home-based trips including work-based other and other-based other trips.

The challenges with computing VMT for these two types of trips in a trip-based model are 1) production and attraction trip-ends are not distinguishable after the productions/attractions (PA) to origin/destination (OD) conversion process and 2) trip purposes are not maintained after the mode choice step. For these reasons, it is not possible to use the VMT results from the standard vehicle assignment (even using a select zone re-assignment). A separate post-process must be developed to re-estimate VMT for each zone that includes trip-end types and trip purposes. In order to provide the most accurate estimates possible, the recommended approach to estimating VMT is outlined below. Deviating from this approach will require justification and approval from the City Traffic Engineer.

4.3.1 VMT Forecasting Instructions

This approach will calculate total Origin/Destination (OD) VMT using standard SCAG model output files. The OD method for calculating total VMT includes all vehicle trips that start in a specific traffic analysis zone, and all vehicle trips that end in a specific traffic analysis zone. The major steps of this approach are listed as follows:

- Re-skim final loaded congested networks and adjust the external skim for each mode and time period to account for truncated trips
- Multiply appropriate distance skim matrices by OD trip matrices to estimate VMT by time period
- Sum matrices by time period and mode to calculate daily automobile VMT
- Calculate automobile VMT for individual TAZs

4.3.2 Appropriateness Checks

The number of vehicle trips from the total VMT estimation should match as closely as possible with the results from the traditional model process. The estimated results should be checked against the results from a full model run to understand the degree of accuracy. Note that these custom processes may or may not include full lengths of IX/XI trips (trips with origins or destinations outside of the model roadway network) or special generator trips (airport, seaport, stadium, etc.).

When calculating VMT for comparison at the study area, citywide, or regional geography, the same methodology that was used to estimate project specific VMT should be used. The VMT for these comparisons can be easily calculated by aggregating the row or column totals for all zones that are within the desired geography.

4.4 Attachment D: VMT Mitigation Strategies

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Employment Measures								
Implement Commute Trip Reduction Program (Voluntary)	This measure will implement a voluntary commute trip reduction (CTR) program with employers. CTR programs discourage single-occupancy vehicle trips and encourage alternative modes of transportation such as carpooling, taking transit, walking, and biking, thereby reducing VMT and GHG emissions. A multi-strategy program implemented by employers on a voluntary basis. The measure must include elements such as: • Carpooling encouragement • Ridesharing • Discounted transit • Guaranteed ride home	Yes	Retail Office Industrial Mixed-Use	T-5	Up to 4% (GHG Handbook)	Employer costs may include recurring costs for transit subsidies, capital and maintenance costs for the alternative transportation infrastructure, and labor costs for staff to manage the program. Where the local municipality has a VMT reduction ordinance, costs may include the labor costs for government staff to track the efficacy of the program.	The TDM calculation should be based on the effectiveness of the program and not each individual measure to avoid double-counting. To avoid double-counting, this measure cannot be applied alongside the Mandatory Commute Trip Reduction Program.	Boarnet, M., H. Hsu, and S. Handy. 2014. Impacts of Employer-Based Trip Reduction Programs and Vanpools on Passenger Vehicle Use and Greenhouse Gas Emissions. September. Available: https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_EmployerBased_Trip_Reduction_Programs_and_Vanpools_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. Accessed: January 2021.
Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)	A similar program to the Voluntary one described above, but where participation is required. A reduction goal is specified and ongoing monitoring and reporting assess the program's effectiveness.	Yes	Retail Office Industrial Mixed-Use	T-6	Up to 26% (GHG Handbook)	Employer costs may include recurring, direct costs for transit subsidies, capital and maintenance costs for alternative transportation infrastructure, and labor costs for staff to manage the program. If the local municipality has a mandatory VMT reduction ordinance, additional employer costs could include non-compliance penalties if the municipality fines CTR programs that do not meet a VMT goal. Municipal costs may include the labor costs for government staff to track the efficacy of the program, which may be outweighed by revenue generated from fines collected from non-compliant businesses.	The TDM calculation should be based on the effectiveness of the program and not each individual measure to avoid double-counting. To avoid double-counting, this measure cannot be applied alongside the Voluntary Commute Trip Reduction Program.	Nelson/Nygaard Consulting Associates. 2015. Genentech–South San Francisco Campus TDM and Parking Report. June. Available: http://ci-ssf-ca.granicus.com/MetaViewer.php?view_id=2&clip_id=859&meta_id=62028. Accessed: January 2021

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Price Workplace Parking	This measure will price onsite parking at workplaces. Because free employee parking is a common benefit, charging employees to park onsite increases the cost of choosing to drive to work. This is expected to reduce single-occupancy vehicle commute trips, resulting in decreased VMT, thereby reducing associated GHG emissions. Implement workplace parking via charging for parking, charge above market rate pricing, and/or validating parking for guests. Reductions apply only if complementary strategies are in place to limit spill-over to on-street parking. Depending on project location and availability of alternative transportation options, implementation of parking measures may require implementing other supportive strategies.	Yes	Retail Office Industrial Mixed-Use	T-12	Up to 20% (GHG Handbook)	Parking fees would be a direct, recurring cost for employees. Employer costs include labor costs for program management and monitoring, but this may be offset by revenue generated by the program		Lehner, S., Peer, S. 2019. The Price Elasticity of Parking: A Meta-analysis. Transportation Research Part A: Policy and Practice 121 2019. Available: http://sustainabletransportationsc.org/garage/pdf/parking_elasticity.pdf. Accessed: January 2021.
Employee Parking Cash-out	Provide employees with a choice of forgoing parking for a cash payment equivalent to the cost of the parking space to the employer. Reductions apply only if complementary strategies are in place to limit spill-over to on-street parking. Depending on project location and availability of alternative transportation options, implementation of parking measures may require implementing other supportive strategies.	Yes	Retail Office Industrial Mixed-Use	T-13	Up to 12% (GHG Handbook)	Employer costs include the recurring, direct cost for payment to program participants and labor costs for program management. Employees that participate in the program would achieve cost savings through the cash-out benefit and potentially through reduced vehicle ownership and usage.	Note this measure can be paired with other commute trip reduction strategies (Measures T-7 through T-11).	Shoup, D. 2005. Parking Cash Out. Planners Advisory Service, American Planning Association. Available: http://shoup.bol.ucla.edu/ParkingCashOut.pdf. Accessed: January 2021.
Implement Market Price Public Parking (On-Street)	This measure will price all on-street parking in a given community, with a focus on parking near central business districts, employment centers, and retail centers.	Might Apply	Retail Office Industrial Mixed-Use	T-24	Up to 30% (GHG Handbook)	Municipalities may incur costs from installing the meter network, which may require meters at individual spaces or at more central terminals. There would also be staffing costs to monitor the metered spaces and collect payments. Residents also incur a cost by having to pay for on-street parking. A portion of costs to the municipality may be offset through revenue collected by the parking system.		Pierce, G., and D. Shoup. 2013. Getting the Prices Right: An Evaluation of Pricing Parking by Demand in San Francisco. Journal of the American Planning Association 79(1)67–81. May. Available: https://www.tandfonline.com/doi/pdf/10.1080/01944363.2013.787307?needAccess=tr Accessed: January 2021.
Residential Measures								
Integrate Affordable and Below Market Rate Housing	This measure requires below market rate (BMR) housing. BMR housing provides greater opportunity for lower income families to live closer to job centers and achieve a jobs/housing match near transit. It is also an important strategy to address the limited availability of affordable housing that might force residents to live far away from jobs or school, requiring longer commutes. The	Yes	Residential Mixed-Use	T-4	Up to 28.6% (GHG Handbook)	Depending on the source of the affordable subsidy, BMR housing may have implications for development costs but would also have the benefit of reducing costs for public services, similar to	Reduction applies to all project-generated trips. Multifamily residential units must be permanently dedicated as affordable for lower income families.	California Department of Housing and Community Development. 2021. Income Limits. Available:https://www.hcd.ca.gov/grants-funding/income-limits/index.shtml#:~:text=%E2%80%9CAffordable%20housing%20cost%E2%80%9D%20for%20lower,of%20gross%20income%2C%20with%20variations. Accessed; November 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
	quantification method for this measure accounts for VMT reductions achieved for multifamily residential projects that are deed restricted or otherwise permanently dedicated as affordable housing.					Measure T-1, Increase Residential Density.		Institute of Transportation Engineers (ITE). 2021. Trip Generation Manual. 11th Edition. Available: https://www.ite.org/technical-resources/topics/trip-and-parking-generation/. Accessed; November 2021.
Limit Residential Parking Supply	This measure will reduce the total parking supply available at a residential project or site. Limiting the amount of parking available creates scarcity and adds additional time and inconvenience to trips made by private auto, thus disincentivizing driving as a mode of travel. Reducing the convenience of driving results in a shift to other modes and decreased VMT and thus a reduction in GHG emissions. Evidence of the effects of reduced parking supply is strongest for residential developments. Eliminate or reduce total parking supply for residential projects or sites. This measure does not work if project is within walking distance of unrestricted street parking or other parking is available.	Might apply	Residential	T-15	Up to 13.7% (GHG Handbook)	Reducing residential parking supply, especially in high density residential areas, can have high-cost savings if it reduces the need for additional investment in parking infrastructure. Some of these savings may be offset by investments in alternative transport solutions, which will need to be robust to ensure that residents can effectively travel to work and all other destinations without a car.	Parking demand is calculated based on project build square footage or number of dwelling units. Reductions are only applied to VMT generated by residents in mixed-use projects.	California Department of Transportation (Caltrans). 2012. California Household Travel Survey (CHTS). Available: https://www.nrel.gov/transportation/secure-transportation-data/tsdc-california-travel-survey.html. Accessed: January 2021. Chatman, D. 2013. Does TOD need the T? On the importance of factors other than rail access. Journal of the American Planning Association 79(1). Available: https://trid.trb.org/view/1243004.Accessed: January 2021. Institute of Transportation Engineers (ITE). 2019. Parking Generation Manual. 5th Edition. February. Available: https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=PG5-ALL. Accessed: May 2021.
Unbundle Residential Parking Costs from Property Cost	This measure will unbundle, or separate, a residential project's parking costs from property costs, requiring those who wish to purchase parking spaces to do so at an additional cost. On the assumption that parking costs are passed through to the vehicle owners/drivers utilizing the parking spaces, this measure results in decreased vehicle ownership and, therefore, a reduction in VMT and GHG emissions. Unbundling may not be available to all residential developments, depending on funding sources. Reductions apply only if complementary strategies are in place to limit spill-over to on-street parking. Note that this may require coordination with the local agency as proposed supply may not be consistent with policy requirements. Depending on project location and availability of alternative transportation options, implementation of parking measures may require implementing other supportive strategies.	Might apply	Residential	T-16	Up to 15.7% (GHG Handbook)	Unbundling residential parking costs from property costs may decrease revenue for property owners. This loss may be partially offset by reduced costs needed to maintain parking facilities with less car occupancy and the potential for non-resident parking as a supplementary income stream. For residents, reduced fees and the ability to go without owning a car is a major cost benefit. Municipalities also benefit from a reduction of cars on the road, which can lead to lower infrastructure and roadway maintenance costs.	Reductions apply to residential land uses only.	AAA. 2019. Your Driving Costs. September. Available: https://exchange.aaa.com/wp-content/uploads/2019/09/AAA-Your-Driving-Costs-2019.pdf. Accessed: January 2021. Federal Highway Administration (FHWA). 2017. National Household Travel Survey – 2017 Table Designer. Annual VMT / Vehicle by Count of Household Vehicles in California. Available: https://nhts.ornl.gov/. Accessed: March 2021. Litman, T. 2020. Parking Requirement Impacts on Housing Affordability. June. Available: https://www.vtpi.org/park-hou.pdf. Accessed: January 2021.
Employment and Residential Measures								
Increase Residential Density	This measure accounts for the VMT reduction achieved by a project that is designed with a higher density of dwelling units (du) compared to the average residential	Yes	Residential Mixed-Use	T-1	30% (GHG Handbook)	Depending on the location, increasing residential density may	Calculations are most accurately quantified for larger developments or	Ewing, R., K. Bartholomew, S. Winkelman, J. Walters, and D. Chen. 2007. Growing Cooler: The

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
	density in the U.S. Increased densities affect the distance people travel and provide greater options for the mode of travel they choose. Increasing residential density results in shorter and fewer trips by single-occupancy vehicles and thus a reduction in GHG emissions. This measure is best quantified when applied to larger developments and developments where the density is somewhat similar to the surrounding area due to the underlying research being founded in data from the neighborhood level. Applied for projects that provide higher density of dwelling units compared to the national average residential density.					increase housing and development costs. However, the costs of providing public services, such as health care, education, policing, and transit, are generally lower in more dense areas where things are closer together. Infrastructure that provides drinking water and electricity also operates more efficiently when the service and transmission area is reduced. Local governments may provide approval streamlining benefits or financial incentives for infill and high-density residential projects.	developments with density somewhat similar to the existing surrounding neighborhood.	Evidence on Urban Development and Climate Change. October. Available: https://www.nrdc.org/sites/default/files/cit_07092401a.pdf. Accessed: January 2021. Stevens, M. 2016. Does Compact Development Make People Drive Less? Journal of the American Planning Association 83:1(7–18), DOI: 10.1080/01944363.2016.1240044. November. Available: https://www.researchgate.net/publication/309890412_Does_Compact_Development_Make_People_Drive_Less. Accessed: January 2021.
Increase Job Density	This measure accounts for the VMT reduction achieved by a project that is designed with a higher density of jobs compared to the average job density in the U.S. Increased densities affect the distance people travel and provide greater options for the mode of travel they choose. Increasing job density results in shorter and fewer trips by single-occupancy vehicles and thus a reduction in GHG emissions. Applied for projects that provide higher density of jobs compared to the national average job density.	Yes	Retail Office Industrial Mixed-Use	T-2	30% (GHG Handbook)	Areas with increased job density generally have higher economic gross metropolitan product (GMP) and job growth. Prosperity, measured as GMP per job, also grows faster in areas with increased job density. Decreased commute times and car use may also generate funds for public transit and reduce the need for infrastructure spending on road maintenance.	Calculations are most accurately quantified for larger developments or developments with density somewhat similar to the existing surrounding neighborhood.	Institute of Transportation Engineers (ITE). Trip Generation Manual. 10th Edition. Available: https://www.ite.org/technical-resources/topics/trip-and-parking-generation/trip-generation-10th-edition-formats/. Accessed: January 2021. Stevens, M. 2016. Does Compact Development Make People Drive Less? Journal of the American Planning Association 83:1(7–18), DOI: 10.1080/01944363.2016.1240044. November. Available: https://www.researchgate.net/publication/309890412_Does_Compact_Development_Make_People_Drive_Less. Accessed: January 2021.
Provide Transit-Oriented Development	TOD refers to projects built in compact, walkable areas that have easy access to public transit, ideally in a location with a mix of uses, including housing, retail offices, and community facilities.	Yes	Residential Retail Office Industrial Mixed-Use	T-3	31% (GHG Handbook)	TOD reduces car use and car ownership rates, providing cost savings to residents. It can also increase property values and public transit use rates, providing additional revenue to municipalities, as well as open new markets for business development. Increased transit use will likely necessitate increased spending on maintaining and improving public transit systems, the costs of which may be high.		Federal Highway Administration. 2017a. National Household Travel Survey–2017 Table Designer.Travel Day PMT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration. 2017b. National Household Travel Survey – 2017 Table Designer. Average Vehicle Occupancy by HHSTFIPS. Available: https://nhts.ornl.gov/. Accessed: January 2021. Lund, H., R. Cervero, and R. Wilson. 2004. Travel Characteristics of Transit-Oriented Development in California. January. Available: https://community-wealth.org/sites/clone.community-wealth.org/files/downloads/report-lund-cerv-wil.pdf. Accessed: January 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Implement Commute Trip Reduction Marketing	This measure will implement a marketing strategy to promote the project site employer's CTR program. Information sharing and marketing promote and educate employees about their travel choices to the employment location beyond driving such as carpooling, taking transit, walking, and biking, thereby reducing VMT and GHG emissions.	Yes	Residential Retail Office Industrial Mixed-Use	T-7	Up to 4.0% (GHG Handbook)	Employer costs include labor and materials for development and distribution of survey and marketing materials to promote the program and educate potential participants.	Quantification applies at citywide scale and must be adjusted to reflect project-specific reductions. VMT mitigation potential is based on analyzing docked (i.e., station-based) programs. Note that percentage VMT reductions from Project-Level and Community-Level measures must be calculated separately.	Transportation Research Board (TRB). 2010. Traveler Response to Transportation System Changes Handbook, Third Edition: Chapter 19, Employer and Institutional TDM Strategies. June. Available: http://www.trb.org/Publications/Blurbs/163781.aspx. Accessed: January 2021.
Provide Ridesharing Program	This measure will implement a ridesharing program and establish a permanent transportation management association with funding requirements for employers. Ridesharing encourages carpooled vehicle trips in place of single-occupied vehicle trips, thereby reducing the number of trips, VMT, and GHG emissions. This strategy focuses on encouraging carpooling by project site/building tenants. Existing ride-share companies could also be leveraged by providing subsidies for shared ride purchases (e.g., Waze Carpool or equivalent).	Yes	Residential Retail Office Industrial Mixed-Use	T-8	Up to 8% (GHG Handbook)	Costs of developing, implementing, and maintaining a rideshare program in a way that encourages participation are generally borne by municipalities or employers. The beneficiaries include the program participants saving on commuting costs, the employer reducing onsite parking expenses, and the municipality reducing cars on the road, which leads to lower infrastructure and roadway maintenance costs.	Project should be within 1 mile of high-quality transit service (rail or bus with headways less than 15 minutes), 0.5 mile of local or less frequent transit service, or along a designated shuttle route providing last-mile connections to rail service.	San Diego Association of Governments (SANDAG). 2019. Mobility Management VMT Reduction Calculator Tool–Design Document. June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Implement Subsidized or Discount Transit Program	This measure will provide subsidized or discounted, or free transit passes for employees and/or residents. Reducing the out-of-pocket cost for choosing transit improves the competitiveness of transit against driving, increasing the total number of transit trips and decreasing vehicle trips. This decrease in vehicle trips results in reduced VMT and thus a reduction in GHG emissions. Example applications include subsidized, discounted, or free out-of-pocket costs for daily or monthly public transit passes.	Yes	Residential Retail Office Industrial Mixed-Use	T-9	Up to 5.5% (GHG Handbook)	The employer cost is the recurring, direct cost for transit subsidies. The subsidies will lower the per capita income of the transit service, decreasing the revenue of the local transit agency. This cost may be offset by increased revenue from increased ridership. The beneficiaries include the program participants saving on commuting cost, the employer reducing onsite parking expenses, and the municipality reducing cars on the road, which leads to lower infrastructure and roadway maintenance costs.	Measure can be paired with other commute trip reduction strategies (Measures T-7 through T-13) for increased reductions. Combined implementation of all measures is capped at 45%.	Federal Highway Administration (FHWA). 2017. National Household Travel Survey–2017 Table Designer. Travel Day PMT by TRPTRANS by HH_CBSA, Workers by WRKTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Handy, L. and S. Boarnet. 2013. Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions. Available: http://www.arb.ca.gov/cc/sb375/policies/transitservice/transit_brief.pdf. Accessed: January 2021. Litman, T. 2020. Transit Price Elasticities and Cross-elasticities. Victoria Transport Policy Institute. April. Available: https://www.vtpi.org/tranelas.pdf. Accessed: January 2021. Taylor, B., D. Miller, H. Iseki, and C. Fink. 2008. Nature and/or Nurture? Analyzing the Determinants of Transit Ridership Across US Urbanized Areas. Transportation Research Part A: Policy and Practice, 43(1), 60-77. Available: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.367.5311&rep=rep1&type=pdf. Accessed: January 2021
Provide End-of-Trip Bicycle Facilities	This measure will install and maintain end-of-trip facilities for employee use. End-of-trip facilities include bike parking, bike lockers, showers, and personal lockers. The provision and maintenance of secure bike parking and related facilities encourages commuting by bicycle, thereby reducing VMT and GHG emissions. Non-residential projects provide facilities such as showers or secure bike lockers to encourage commuting by bike. This strategy is supportive in nature and can help boost the effectiveness of the other strategies listed.	Yes	Retail Office Industrial Mixed-Use	T-10	Up to 4.4% (GHG Handbook)	Employer costs include capital and maintenance costs for construction and maintenance of facilities and potentially labor and materials costs for staff to monitor facilities and provide marketing to encourage use of new facilities. The beneficiaries include the program participants saving on commuting cost, the employer reducing onsite parking expenses, and the municipality reducing cars on the road, which leads to lower infrastructure and roadway maintenance costs.	Measure could be paired with other commute trip reduction measures (Measures T-8 through T-13) as a comprehensive CTR program (Measure T-5 or T-6). Combined implementation of all measures is capped at 45%.	Buehler, R. 2012. Determinants of bicycle commuting in the Washington, DC region: The role bicycle parking, cyclist showers, and free car parking at work. Transportation Research Part D, 17, 525–531. Available: http://www.pedbikeinfo.org/cms/downloads/DeterminantsofBicycleCommuting.pdf. Accessed: January 2021. Federal Highway Administration (FHWA). 2017a. National Household Travel Survey–2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2017b. National Household Travel Survey–2017 Table Designer. Workers by WRKTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Provide Employer-Sponsored Vanpool	Program offering employer-purchased or leased vehicles to provides groups of 5 to 15 people a flexible and cost-effective rideshare commuting option.	Yes	Office Industrial Mixed-Use	T-11	Up to 20.4% (GHG Handbook)	Employer costs primarily include the capital costs of vehicle acquisition and the labor costs of drivers, either through incentives to current employees or the hiring of dedicated drivers. The beneficiaries include the program participants saving on commuting cost, the employer reducing onsite parking expenses, and the municipality reducing cars on the road, which leads to lower infrastructure and roadway maintenance costs.	Measure could be paired with other commute trip reduction measures (Measures T-7 through T-13).	California Air Resources Board (CARB). 2020. EMFAC2017 v1.0.3. August. Available: https://arb.ca.gov/emfac/emissions-inventory. Accessed: January 2021. Federal Highway Administration (FHWA). 2017. National Household Travel Survey–2017 Table Designer. Travel Day VT by HH_CBSA by TRPTRANS by TRIPPURP. Available: https://nhts.ornl.gov/. Accessed: January 2021. Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp. Available: https://www.ipcc.ch/report/ar4/wg1/.Accessed: January 2021. San Diego Association of Governments (SANDAG). 2019. Mobility Management VMT Reduction Calculator Tool–Design Document. June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021.

Provide Electric Vehicle Charging Infrastructure	Install onsite electric vehicle chargers in an amount beyond what is required by the 2019 California Green Building Standards (CALGreen) at buildings with designated parking areas (e.g., commercial, educational, retail, multifamily). This will enable drivers of PHEVs to drive a larger share of miles in electric mode (eVMT), as opposed to gasoline-powered mode, thereby displacing GHG emissions from gasoline consumption with a lesser amount of indirect emissions from electricity. Most PHEVs owners charge their vehicles at home overnight. When making trips during the day, the vehicle will switch to gasoline mode if/when it reaches its maximum all-electric range.	Yes	Residential Retail Office Industrial Mixed-Use	T-14	Up to 11.9% (GHG Handbook)	The primary costs associated with electric vehicle charging infrastructure include the capital costs of purchasing and installing charging stations, electricity costs from use of stations, and maintenance costs of keeping the charging stations in working order. Costs initially fall to the station owners, either municipalities or private owners, but can be passed along to station users with usage fees. Depending on station placement and charging times required for PHEVs, businesses near charging stations can derive benefits from patronage of station users.	Reduction is calculated for all household trips in the surrounding neighborhood, offsetting VMT impacts arising from the project. VMT reduction is associated with expansion of sidewalk coverage, which includes building of new sidewalks and improving degraded or substandard sidewalk. Sidewalk measurements should be collected on both sides of the street. A reasonableness check should be performed using an average walk trip length of 0.5 miles to determine how many new walk trips result from this measure. If the VMT reduced divided by 0.5 miles results in a large number of new daily walk trips, the VMT reduction should be adjusted. Note that percentage VMT reductions from Project-Level and Community-Level measures must be calculated separately.	California Air Resources Board (CARB). 2017. Advanced Clean Cars Mid-Term Report, Appendix G: Plug-in Electric Vehicle In-Use and Charging Data Analysis. Available: https://ww2.arb.ca.gov/resources/documents/2017-midterm-review-report. Accessed: January 2021. California Air Resources Board (CARB). 2019. Final Sustainable Communities Strategy Program and Evaluation Guidelines Appendices. November. Available: https://ww2.arb.ca.gov/sites/default/files/201911/Final%20SCS%20Program%20and%20Evaluation%20Guidelines%20Appendices.pdf. Accessed: January 2021. California Air Resources Board (CARB). 2020a. EMFAC2017 v1.0.3. August. Available: https://arb.ca.gov/emfac/emissions-inventory. Accessed: January 2021. California Air Resources Board (CARB). 2020b. Unofficial electronic version of the Low Carbon Fuel Standard Regulation. Available: https://ww2.arb.ca.gov/sites/default/files/2020-07/2020_lcfs_fro_oal-approved_unofficial_06302020.pdf California Air Resources Board (CARB). 2021. OFFROAD2017–ORION. Available: https://arb.ca.gov/emfac/emissions-inventory. Database queried by Ramboll and provided electronically to ICF. March 2021. California Utilities. 2021. Excel database of GHG emission factors for delivered electricity, provided to the Sacramento Metropolitan Air Quality Management District and ICF. January through March 2021. California Building Standards Commission (CBSC). 2019. Green Building Standards Code, Title 24, Part 11. Appendix A5 – Nonresidential Voluntary Measures. Table A5.601 Nonresidential Buildings: Green Building Standards Code Proposed Performance Approach. July. Available: https://codes.iccsafe.org/content/CAGBSC2019/appendix-a5-nonresidential-voluntary-measures. Accessed: May 2021. Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp. Available: https://www.ipcc.ch/report/ar4/wg1/. Accessed: January 2021. U.S. Department of Energy (U.S. DOE). 2021. Download Fuel Economy Data. January. Available: https://www.fueleconomy.gov/feg/download.shtml. Accessed: January 2021.

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Provide Pedestrian Network Improvements	This measure will increase the sidewalk coverage to improve pedestrian access. Providing sidewalks and an enhanced pedestrian network encourages people to walk instead of drive. This mode shift results in a reduction in VMT and GHG emissions.	Might apply	Residential Retail Office Industrial Mixed-Use	T-18	Up to 6.4% (GHG Handbook)	Depending on the improvement, capital and infrastructure costs may be high. However, improvements to the pedestrian network will increase pedestrian activity, which can increase businesses patronage and provide a local economic benefit. The local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.	Reduction is calculated for all trips in the surrounding neighborhood, offsetting VMT impacts arising from the project. This measure reduces VMT on the roadway segment parallel to the bicycle facility (i.e., the corridor). An adjustment factor is included in the formula to scale the VMT reduction from the corridor level to the plan/community level. A reasonableness check should be performed using an average bike trip length of 2 miles to determine how many new bike trips result from this measure. If the VMT reduced divided by 2 miles results in a large number of new daily bike trips, the VMT reduction should be adjusted. Note that percentage VMT reductions from Project-Level and Community-Level measures must be calculated separately.	Frank, L., M. Greenwald, S. Kavage, and A. Devlin. 2011. An Assessment of Urban Form and Pedestrian and Transit Improvements as an Integrated GHG Reduction Strategy. WSDOT Research Report WA-RD 765.1, Washington State Department of Transportation. April. Available: www.wsdot.wa.gov/research/reports/fullreports/765.1.pdf. Accessed: January 2021. Handy, S., S. Glan-Claudia, and M. Boarnet. 2014. Impacts of Pedestrian Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions: Policy Brief. September. Available: https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_Pedestrian_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. Accessed: January 2021.
Construct or Improve Bike Facility	This measure will construct or improve a single bicycle lane facility (only Class I, II, or IV) that connects to a larger existing bikeway network. Providing bicycle infrastructure helps to improve biking conditions within an area. This encourages a mode shift on the roadway parallel to the bicycle facility from vehicles to bicycles, displacing VMT and thus reducing GHG emissions. When constructing or improving a bicycle facility, a best practice is to consider local or state bike lane width standards. A variation of this measure is provided as T-19-B, Construct or Improve Bike Boulevard.	Might apply	Residential Retail Office Industrial Mixed-Use	T-19-A	Up to 0.8% (GHG Handbook)	Capital and infrastructure costs for new bike facilities may be high. The local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.		Buehler, R. 2012. Determinants of bicycle commuting in the Washington, DC region: The role bicycle parking, cyclist showers, and free car parking at work. Transportation Research Part D, 17, 525–531. Available: http://www.pedbikeinfo.org/cms/downloads/DeterminantsofBicycleCommuting.pdf. Accessed: January 2021. Federal Highway Administration (FHWA). 2017a. National Household Travel Survey–2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2017b. National Household Travel Survey–2017 Table Designer. Workers by WRKTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021

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Construct or Improve Bike Boulevard	Construct or improve a single bicycle boulevard that connects to a larger existing bikeway network. Bicycle boulevards are a designation within Class III Bikeway that create safe, low-stress connections for people biking and walking on streets. This encourages a mode shift from vehicles to bicycles, displacing VMT and thus reducing GHG emissions. A variation of this measure is provided as T-19-A, Construct or Improve Bike Facility, which is for Class I, II, or IV bicycle infrastructure.	Might apply	Retail Office Industrial Mixed-Use	T-19-B	Up to 0.2% (GHG Handbook)	Capital and infrastructure costs for new bike boulevards may be high, though lower than implementing the same length of protected bicycle lanes (Class IV). After the bike boulevard is complete, the local municipality may achieve cost savings from reduced infrastructure and roadway maintenance costs.		California Air Resources Board (CARB), California Department of Public Health (CDPH), and Nicholas Linesch Legacy Fund. 2020. Integrated Transport and Health Impact Model. Available: https://skylab.cdph.ca.gov/HealthyMobilityOptionTool-ITHIM/#Home. Accessed: September 17, 2021. Federal Highway Administration (FHWA). 2017a. National Household Travel Survey–2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2017b. National Household Travel Survey–2017 Table Designer. Workers by WRKTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Schwartz, S. 2021. Planning for Stress Free Connections: Estimating VMT Reductions. February.
Implement Conventional Carshare Program	This measure will increase carshare access in the user's community by deploying conventional carshare vehicles. Carsharing offers people convenient access to a vehicle for personal or commuting purposes. This helps encourage transportation alternatives and reduces vehicle ownership, thereby avoiding VMT and associated GHG emissions.	Might apply	Residential Retail Office Industrial Mixed-Use	T-21-A	Up to 0.15% (GHG Handbook)	The costs incurred by the carshare program service manager (typically a municipality or carshare company) may include the capital costs of purchasing vehicles; costs of storing, maintaining, and replacing the fleet; and costs for marketing and administration. Some of these costs may be offset by income generated through program use.		Martin, E. and S. Shaheen. 2016. The Impacts of Car2go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities. July. Available: https://tsrc.berkeley.edu/publications/impacts-car2go-vehicle-ownership-modal-shift-vehicle-miles-traveled-and-greenhouse-gas. Accessed: March 2021. San Diego Association of Governments (SANDAG). 2019. Mobility Management VMT Reduction Calculator Tool – Design Document. June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021.

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Implement Electric Carshare Program	This measure will increase carshare access in the user's community by deploying electric carshare vehicles. Carsharing offers people convenient access to a vehicle for personal or commuting purposes. This helps encourage transportation alternatives and reduces vehicle ownership, thereby avoiding VMT and associated GHG emissions. This also encourages a mode shift from internal combustion engine vehicles to electric vehicles, displacing the emissions-intensive fossil fuel energy with less emissions-intensive electricity. Electric carshare vehicles require more staffing support compared to conventional carshare programs for shuttling electric vehicles to and from charging points.	Might apply	Residential Retail Office Industrial Mixed-Use	T-21-B	Up to 0.18% (GHG Handbook)	Costs incurred by the service manager (e.g., municipality, carshare company) may include the capital costs of purchasing vehicles; costs of storing, maintaining, and replacing the fleet; and costs for marketing and administration. Some of these costs may be offset by income generated through program use. Participants' recurring costs of renting a carshare vehicle may be offset by the cost savings from access to cheaper transportation.		California Air Resources Board (CARB). 2020a. EMFAC2017 v1.0.3. August. Available: https://arb.ca.gov/emfac/emissions-inventory. Accessed: January 2021. California Air Resources Board (CARB). 2020b. Unofficial electronic version of the Low Carbon FuelStproved_unofficial_06302020.pdf California Utilities. 2021. Excel database of GHG emission factors for delivered electricity, provided to the Sacramento Metropolitan Air Quality Management District and ICF. January through March 2021. Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp. Available: https://www.ipcc.ch/report/ar4/wg1/. Accessed: January 2021. Martin, E. and Shaheen, S. 2016. The Impacts of Car2go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities. July. Available: https://tsrc.berkeley.edu/publications/impacts-car2go-vehicle-ownership-modal-shift-vehicle-miles-traveled-and-greenhouse-gas. Accessed: March 2021. San Diego Association of Governments (SANDAG). 2019. Mobility Management VMT Reduction Calculator Tool – Design Document. June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021. U.S. Department of Energy (U.S. DOE). 2021. Download Fuel Economy Data. January. Available: https://www.fueleconomy.gov/feg/download.shtml. Accessed: January 2021.

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Implement Pedal (Non-Electric) Bikeshare Program	This measure will establish a bikeshare program. Bikeshare programs provide users with on-demand access to bikes for short-term rentals. This encourages a mode shift from vehicles to bicycles, displacing VMT and thus reducing GHG emissions. Variations of this measure are described in Measure T-22-B, Implement Electric Bikeshare Program, and Measure T-22-C, Implement Scootershare Program. Note that this measure is most applicable to the denser suburban areas and will be most effective when complemented by enhanced bike facilities.	Might apply	Residential Retail Office Industrial Mixed-Use	T-22-A	Up to 0.02% (GHG Handbook)	The costs incurred by the service manager (e.g., municipality or bikeshare company) may include the capital costs for purchasing a bicycle fleet; installing accessible and secure docking stations; storing, maintaining, and replacing the fleet; and marketing and administration. Some of these costs may be offset by income generated through program use. Program participants will benefit from the cost savings from access to cheaper transportation alternatives (compared to private vehicles, private bicycles, or use of ride-hailing services). The local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.	VMT mitigation potential is based on analyzing docked (i.e., station-based) programs. Note that percentage VMT reductions from Project-Level and Community-Level measures must be calculated separately.	Federal Highway Administration (FHWA). 2017. National Household Travel Survey–2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2018. Summary of Travel Trends 2017–National Household Travel Survey. July. Available: https://www.fhwa.dot.gov/policyinformation/documents/2017_nhts_summary_travel_trends.pdf. Accessed: January 2021. Lazarus, J., J. Pourquier, F. Feng, H. Hammel, and S. Shaheen. 2019. Bikesharing Evolution and Expansion: Understanding How Docked and Dockless Models Complement and Compete – A Case Study of San Francisco. Paper No. 19-02761. Annual Meeting of the Transportation Research Board: Washington, D.C. Available: https://trid.trb.org/view/1572878. Accessed: January 2021. McQueen, M., G. Abou-Zeid, J. MacArthur, and K. Clifton. 2020. Transportation Transformation: Is Micromobility Making a Macro Impact on Sustainability? Journal of Planning Literature. November. Available: https://doi.org/10.1177/0885412220972696. Accessed: March 2021. Metropolitan Transportation Commission (MTC). 2017. Plan Bay Area 2040 Final Supplemental Report–Travel Modeling Report. July. Available: http://2040.planbayarea.org/files/2020-02/Travel_Modeling_PBA2040_Supplemental%20Report_7-2017.pdf. Accessed: January 2021.
Implement Electric Bikeshare Program	This measure will establish an electric bikeshare program. Electric bikeshare programs provide users with on-demand access to electric pedal assist bikes for short-term rentals. This encourages a mode shift from vehicles to electric bicycles, displacing VMT and reducing GHG emissions. Variations of this measure are described in Measure T-22-A, Implement Pedal (Non-Electric) Bikeshare Program, and Measure T-22-C, Implement Scootershare Program.	Might apply	Residential Retail Office Industrial Mixed-Use	T-22-B	Up to 0.06% (GHG Handbook)	The costs incurred by the service manager (e.g., municipality or bikeshare company) may include the capital costs for purchasing a bicycle fleet; installing accessible and secure charging stations; storing, maintaining, and replacing the fleet; and marketing and administration. Some of these costs may be offset by income generated through program use. Program participants will benefit from the cost savings from access to cheaper transportation alternatives (compared to private vehicles, private bicycles, or use of ride-hailing services). The local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.	VMT mitigation potential is based on analyzing docked (i.e., station-based) programs. Note that percentage VMT reductions from Project-Level and Community-Level measures must be calculated separately.	Federal Highway Administration (FHWA). 2017. National Household Travel Survey–2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2018. Summary of Travel Trends 2017–National Household Travel Survey. July. Available: https://www.fhwa.dot.gov/policyinformation/documents/2017_nhts_summary_travel_trends.pdf. Accessed: January 2021. Fitch, D., H. Mohiuddin, and S. Handy. 2021. Examining the Effects of the Sacramento Dockless E-Bike Share on Bicycling and Driving. MDPI: Sustainability. January. Available: https://www.mdpi.com/2071-1050/13/1/368. Accessed: March 2021. Metropolitan Transportation Commission (MTC). 2017. Plan Bay Area 2040 Final Supplemental Report–Travel Modeling Report. July. Available: http://2040.planbayarea.org/files/202002/Travel_Modeling_PBA2040_Supplemental%20Report_7-2017.pdf. Accessed: January 2021.

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Implement Scootershare Program	This measure will establish a scootershare program. Scootershare programs provide users with on-demand access to electric scooters for short-term rentals. This encourages a mode shift from vehicles to scooters, displacing VMT and thus reducing GHG emissions.	Might apply	Residential Retail Office Industrial Mixed-Use	T-22-C	Up to 0.07% (GHG Handbook)	The costs incurred by the service manager (e.g., municipality or scootershare company) may include the capital costs for purchasing a scooter fleet; installing accessible and secure docking stations; storing, maintaining, and replacing the fleet; and marketing and administration. Some of these costs may be offset by income generated through program use. Program participants will benefit from cost savings from access to cheaper transportation alternatives (compared to private vehicles, private scooters, or use of ride-hailing services). The local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.	VMT mitigation potential is based on analyzing docked (i.e., station-based) programs. Note that percentage VMT reductions from Project-Level and Community-Level measures must be calculated separately.	Federal Highway Administration (FHWA). 2017. National Household Travel Survey–2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2018. Summary of Travel Trends 2017–National Household Travel Survey. July. Available: https://www.fhwa.dot.gov/policyinformation/documents/2017_nhts_summary_travel_trends.pdf. Accessed: January 2021. Metropolitan Transportation Commission (MTC). 2017. Plan Bay Area 2040 Final Supplemental Report–Travel Modeling Report. July. Available: http://2040.planbayarea.org/files/202002/Travel_Modeling_PBA2040_Supplemental%20Report_7-2017.pdf. Accessed: January 2021. McQueen, M., G. Abou-Zeid, J. MacArthur, and K. Clifton. 2020. Transportation Transformation: Is Micromobility Making a Macro Impact on Sustainability? Journal of Planning Literature. November. Available: https://doi.org/10.1177/0885412220972696. Accessed: March 2021. Portland Bureau of Transportation (PBOT). 2021. Portland Bureau of Transportation E-Scooter Dashboard. Available: https://public.tableau.com/profile/portland.bureau.of.transportation#!/vizhome/PBOTE ScooterTripsDashboard/ScooterDashboard. Accessed: March 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Extend Transit Network Coverage or Hours	This measure will expand the local transit network by either adding or modifying existing transit service or extending the operation hours to enhance the service near the project site. Starting services earlier in the morning and/or extending services to late-night hours can accommodate the commuting times of alternative-shift workers. This will encourage the use of transit and therefore reduce VMT and associated GHG emissions.	Might apply (coordination with transit agency required)	Residential Retail Office Industrial Mixed-Use	T-25	4.6% (GHG Handbook)	Infrastructure costs for extending the physical network coverage of a transit system can be significant. Costs to expand track-dependent transit, such as light rail and passenger rail, are high and can require resource- and time-intensive advanced planning. Costs to expand vehicle-dependent transit, such as busses, are likewise high but may be limited to procurement of additional vehicles. Any expansion of transit, including just service hours, would increase staffing and potentially maintenance costs. A portion of these costs may be offset by increased transit usage and associated income. Commuters who may more easily be able to travel without a car may also observe cost savings from reduce vehicle usage or ownership.	This measure could be paired with Measure 26.	Federal Highway Administration (FHWA). 2017. National Household Travel Survey–2017 Table Designer. Average Vehicle Occupancy by HHSTFIPS. Available: https://nhts.ornl.gov/. Accessed: January 2021. Handy, S., K. Lovejoy, M. Boarnet, and S. Spears. 2013. Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions. October. Available: https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_Transit_Service_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. Accessed: January 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Increase Transit Service Frequency	Increase transit frequency on one or more transit lines serving the plan/community. Increased transit frequency reduces waiting and overall travel times, which improves the user experience and increases the attractiveness of transit service.	Might apply (coordination with transit agency required)	Residential Retail Office Industrial Mixed-Use	T-26	11.3% (GHG Handbook)	Increasing transit service frequency may require capital investment to purchase additional vehicles. Staff and maintenance costs may also increase. A portion of these costs may be offset by increased transit usage and associated income. Commuters who may more easily be able to travel without a car may also observe cost savings from reduce vehicle usage or ownership.	This measure could be paired with Measure 25.	California Air Resources Board (CARB). 2020. EMFAC2017 v1.0.3. August. Available: https://arb.ca.gov/emfac/emissions-inventory. Accessed: January 2021. Federal Highway Administration (FHWA). 2017a. National Household Travel Survey–2017 Table Designer. Travel Day PMT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2017b. National Household Travel Survey–2017 Table Designer. Average Vehicle Occupancy by HHSTFIPS. Available: https://nhts.ornl.gov/. Accessed: January 2021. Handy, S., K. Lovejoy, M. Boarnet, S. Spears. 2013. Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions. October. Available: https://ww2.arb.ca.gov/sites/default/files/202006/Impacts_of_Transit_Service_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. Accessed: January 2021. San Diego Association of Governments (SANDAG). 2019. Mobility Management VMT Reduction Calculator Tool–Design Document. June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021. U.S. Department of Energy (U.S. DOE). 2021. Fuel Economy Datasets for All Model Years (1984-2021). January. Available: https://www.fueleconomy.gov. Accessed: January 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Implement Transit-Supportive Roadway Treatments	This measure will implement transit-supportive treatments on the transit routes serving the plan/community. Transit-supportive treatments incorporate a mix of roadway infrastructure improvements and/or traffic signal modifications to improve transit travel times and reliability. This results in a mode shift from single occupancy vehicles to transit, which reduces VMT and the associated GHG emissions.	Might apply (coordination with transit agency required)	Residential Retail Office Industrial Mixed-Use	T-27	0.6% (GHG Handbook)	Costs and savings of transit-supportive roadway treatments vary depending on the strategy pursued, ranging from low-cost route optimization changes to high-cost infrastructure projects (e.g., bus-only lanes). Reducing route cycle time without significantly increasing the number of transit vehicles can result in net cost savings for the transit system. Dedicated transit infrastructure will improve transit reliability and increase ridership. This supplements existing transit income streams for municipalities. Increased ridership similarly reduces vehicle use, which has cost benefits for both commuters and municipalities.	This measure could be paired with other Transit subsector strategies (Measure T-25 and Measure T-29).	Federal Highway Administration (FHWA). 2017a. National Household Travel Survey–2017 Table Designer. Travel Day PMT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2017b. National Household Travel Survey–2017 Table Designer. Average Vehicle Occupancy by HHSTFIPS. Available: https://nhts.ornl.gov/. Accessed: January 2021. Transportation Research Board (TRB). 2007. Transit Cooperative Research Program Report 118: Bus Rapid Transit Practitioner's Guide. Available: https://nacto.org/docs/usdg/tcrp118brt_practitioners_kittleson.pdf. Accessed: January 2021.

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Provide Bus Rapid Transit	Converting existing bus routes to a bus rapid transit (BRT) system. Improvements include: • Exclusive right-of-way • Enhanced station design • Advanced technology buses	Might apply (coordination with transit agency required)	Residential Retail Office Industrial Mixed-Use	T-28	13.8% (GHG Handbook)	Providing BRT will require capital investment to purchase specialized vehicles, develop passenger information systems, and construct stations and busways. Total costs vary depending on the suite of BRT components pursued. Grade-separated busways are more expensive than at-grade busways and mixed flow lanes. Dedicated transit infrastructure will improve transit reliability and increase ridership. This supplements existing transit income streams for municipalities. Increased ridership similarly reduces vehicle use, which has cost benefits for both commuters and municipalities.	This measure could be paired with Measure T-25 and Measure T-29.	California Air Resources Board (CARB). 2020. EMFAC2017 v1.0.3. August. Available: https://arb.ca.gov/emfac/emissions-inventory. Accessed: January 2021. Federal Highway Administration (FHWA). 2017a. National Household Travel Survey–2017 Table Designer. Travel Day PMT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2017b. National Household Travel Survey–2017 Table Designer. Average Vehicle Occupancy by HHSTFIPS. Available: https://nhts.ornl.gov/. Accessed: January 2021. Handy, S., K. Lovejoy, M. Boarnet, and S. Spears. 2013. Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions. October. Available: https://ww2.arb.ca.gov/sites/default/files/202006/Impacts_of_Transit_Service_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. Accessed: January 2021. San Diego Association of Governments (SANDAG). 2019. Mobility Management VMT Reduction CalculatorTool–Design Document. June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021. Transportation Research Board (TRB). 2007. Transit Cooperative Research Program Report 118: Bus Rapid Transit Practitioner's Guide. Available: https://nacto.org/docs/usdg/tcrp118brt_practitioners_kittleson.pdf. Accessed: January 2021. U.S. Department of Energy (U.S. DOE). 2021. Fuel Economy Datasets for All Model Years (1984-2021). January. Available: https://www.fueleconomy.gov. Accessed: January 2021

Method	Description	Applies at Project Scale?	Applicable Land Use	GHG Handbook Measure (if applicable)[1]	Range of Effectiveness[3]	Cost Considerations	GHG Handbook Calculation Notes	Literature or Evidence Cited
Reduce Transit Fares	This measure will reduce transit fares on the transit lines serving the plan/community. A reduction in transit fares creates incentives to shift travel to transit from single-occupancy vehicles and other traveling modes, which reduces VMT and associated GHG emissions. This measure differs from Measure T-8, Implement Subsidized or Discounted Transit Program, which can be offered through employer-based benefits programs in which the employer fully or partially pays the employee's cost of transit.	Might apply (coordination with transit agency required)	Residential Retail Office Industrial Mixed-Use	T-29	1.2% (GHG Handbook)	Reducing transit fares will lower the per capita income of the transit service. This may be outweighed by increased ridership, and savings on infrastructure costs due to reduced car usage. Reduced fares can be targeted to specific populations or groups, depending on need. Individuals receiving the reduced fare will obtain a cost savings.		Federal Highway Administration (FHWA). 2017a. National Household Travel Survey–2017 Table Designer. Travel Day PMT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021. Federal Highway Administration (FHWA). 2017b. National Household Travel Survey–2017 Table Designer. Average Vehicle Occupancy by HHSTFIPS. Available: https://nhts.ornl.gov/. Accessed: January 2021. Handy, S., K. Lovejoy, M. Boarnet, and S. Spears. 2013. Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions. October. Available: https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_Transit_Service_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. Accessed: January 2021. San Diego Association of Governments (SANDAG). 2019. Mobility Management VMT Reduction Calculator Tool–Design Document. June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021.

Source: Fehr & Peers, 2022.

1 Refer to updated information contained in the 2021 GHG Handbook. CAPCOA (2021) Each measure is numbered alphanumerically with the first letter of the emissions sector serving as the letter code (e.g., T=Transportation).
2 Reflects types of trips affected (GHG Handbook) and/or scale of application.
3 Range of effectiveness is based on the 2021 GHG Handbook unless otherwise specified. Measures that are "not quantified, grouped, and/or supporting" measures without a range provided are those that have not been researched in order to determine their individual effectiveness. Measures that are not quantified are not included in the table.